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A MODIFIED BECKMAN MODEL DU SPECTROPHOTOMETER FOR SEAGOING USE

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A MODIFIED BECKMAN MODEL DU SPECTROPHOTOMETER FOR SEAGOING USE

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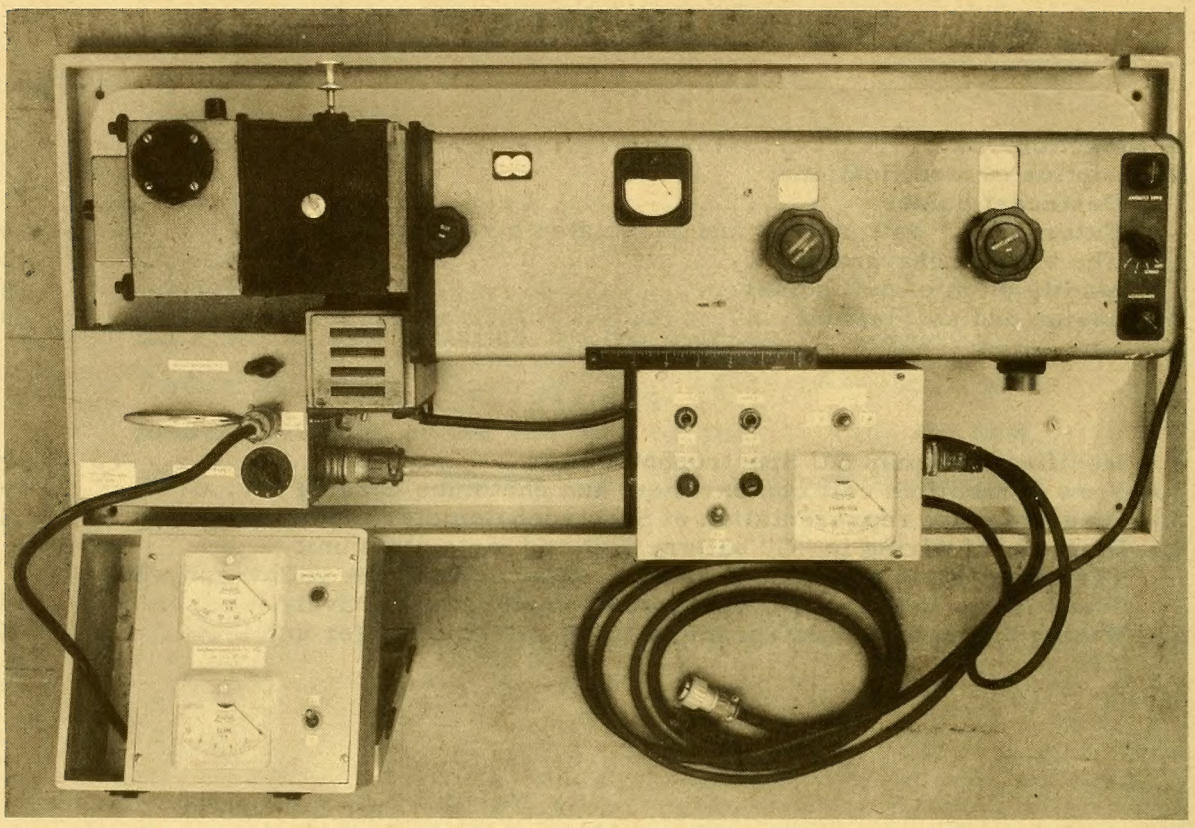

Figure 1.--Modified Beckman DU Spectrophotometer.

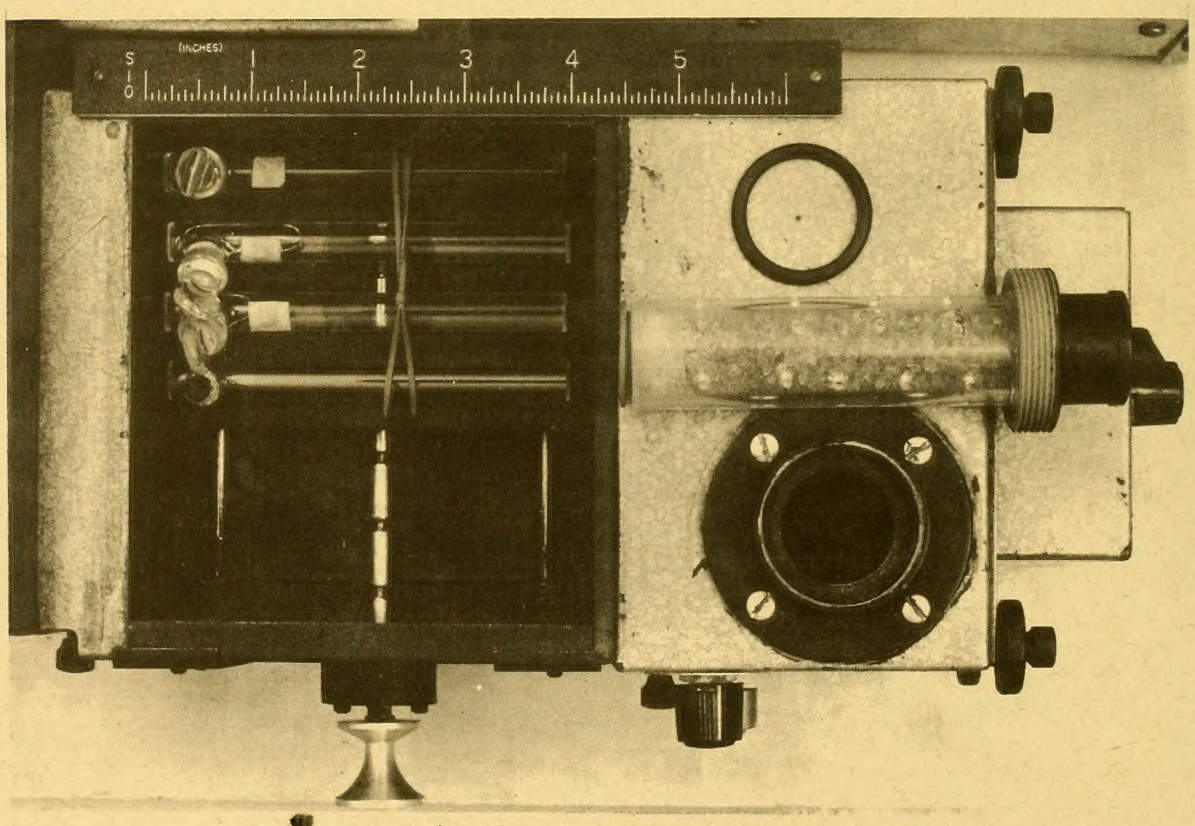

Figure 2.--View of modified cell compartment and phototube housing.

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ABSTRACT

Several modifications of the Beckman DU Spectrophotometer are described which facilitate operation and maintenance on a seagoing vessel. These include the replacement of the desiccant holders in the instrument with readily accessible units of somewhat larger volume; the placement of the "C" battery supply in a separate compartment provided with a switch and meter jack, permitting rapid measurement of critical voltages; two trickle chargers for the 6-volt "A" batteries, provided with rate-of-charge meters; and a cell holder designed to accommodate as many as four 10 cm. semimicroabsorption cells.

INTRODUCTION

Certain modifications of many kinds of commercial instruments are required for their most effective use on an oceanographic vessel. Among the most troublesome conditions with which one must cope on a research vessel are (1) corrosion by salt air and moisture; (2) roll, pitch, vibration, and other motion of the vessel; and (3) general lack of time and space for complex maintenance and repair procedures. Coping with these difficult conditions at sea has led the authors to make a number of modifications in the Beckman Model DU Spectrophotometer which improve the reliability of operation and simplify maintenance. Such modifications have been made on two Model DU Spectrophotometers, and these instruments have given excellent service on several expeditions and cruises during the past 2 years.

DESCRIPTION OF MODIFICATIONS

Desiccant Holders

The moist air encountered on a vessel in a nonair-conditioned laboratory requires a frequent change of desiccant, especially in the phototube housing. In this latter unit, desiccant changes are required every 3-5 days when operating in the tropics and somewhat less frequently in more northern latitudes. The desiccant holders provided with the instrument are difficult to fill; e.g., to change the phototube housing desiccant, the cell compartment must be detached from the phototube housing and the back plate of the phototube housing unscrewed to gain access to the desiccant holder.

These difficulties have been remedied to a large degree by the construction of two transparent plastic, perforated tubes which may be screwed into receptacles mounted on the instrument. Silicone grease-coated O-rings serve as moisture seals in these units. The top of the desiccant cartridge used in the phototube house is made light-tight (this is not necessary with the other desiccant unit); inspection of desiccant condition is made by unscrewing the cartridge in the phototube house--an operation that requires only a few seconds. Desiccant in the cartridge is removed by loosening a plastic cup which is inserted in the bottom of the plastic cartridge. In figure 1 these cartridges are shown mounted in position, and in figure 2 a close-up view

Note.--Robert W. Holmes, Assistant Research Biologist, and Robert J. Linn, Senior Marine Technician, Scripps Institution of Oceanography, La Jolla, California.

shows the desiccant cartridge, the O-ring, and the receptacle as used on the phototube house.

External "C" Battery Unit and Associated Circuitry

Many investigators as well as the manufacturer have resorted to an external "C" battery supply. This permits the changing of the "C" batteries without inverting the instrument and removing the bottom plate. Additional modifications (fig. 4) which we have found advantageous are: (1) the inclusions of an extra "C" battery in series with Beckman batteries Nos. 3 and 4--this extra battery reduces the frequency of battery renewal, (2) the inclusion of a four-position rotary switch which permits adjustment of the screen voltage without entry into the "C" battery unit, and (3) the inclusion of another rotary switch (2-deck, 11-position) and a test meter outlet which permits the operator to check voltages on the terminal strip.

A portable test meter has also been constructed which facilitates the voltage measurements. This unit (fig. 4) has a reverse polarity switch, two volt meters, and an on-off push-button switch.

These "C" battery and test meter units may be seen in figure 1 located adjacent to the phototube housing. The circuitry is diagrammed in figures 3 and 4.

The Battery Charger Unit

For convenience the battery charger unit has been mounted alongside the spectrophotometer above the transmittance dial (fig. 1). This unit contains two conventional 6-volt trickle chargers with provision for charging two 6-volt storage batteries simultaneously or independently, and a panel

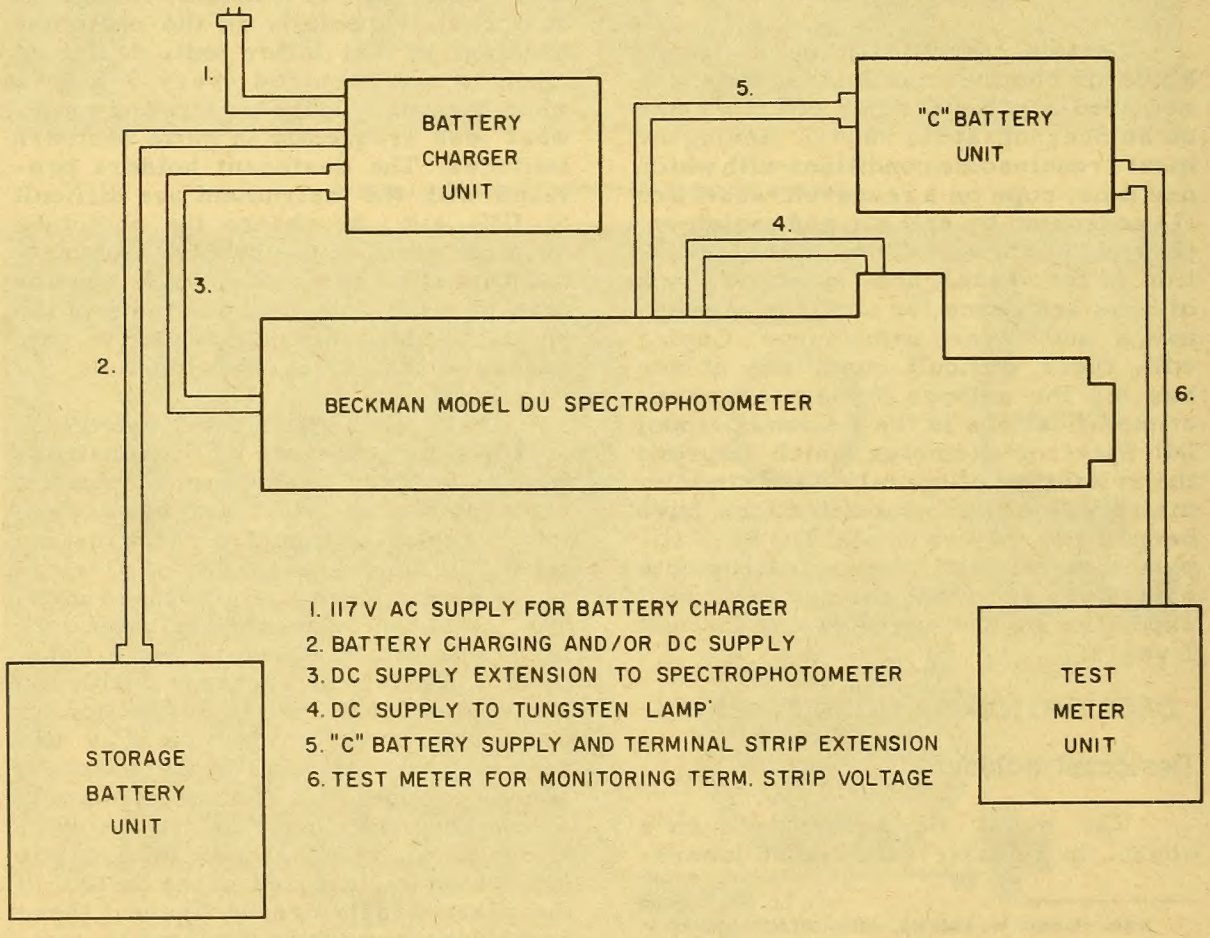

Figure 3.--Diagrammatic representation of Spectrophotometer modification.

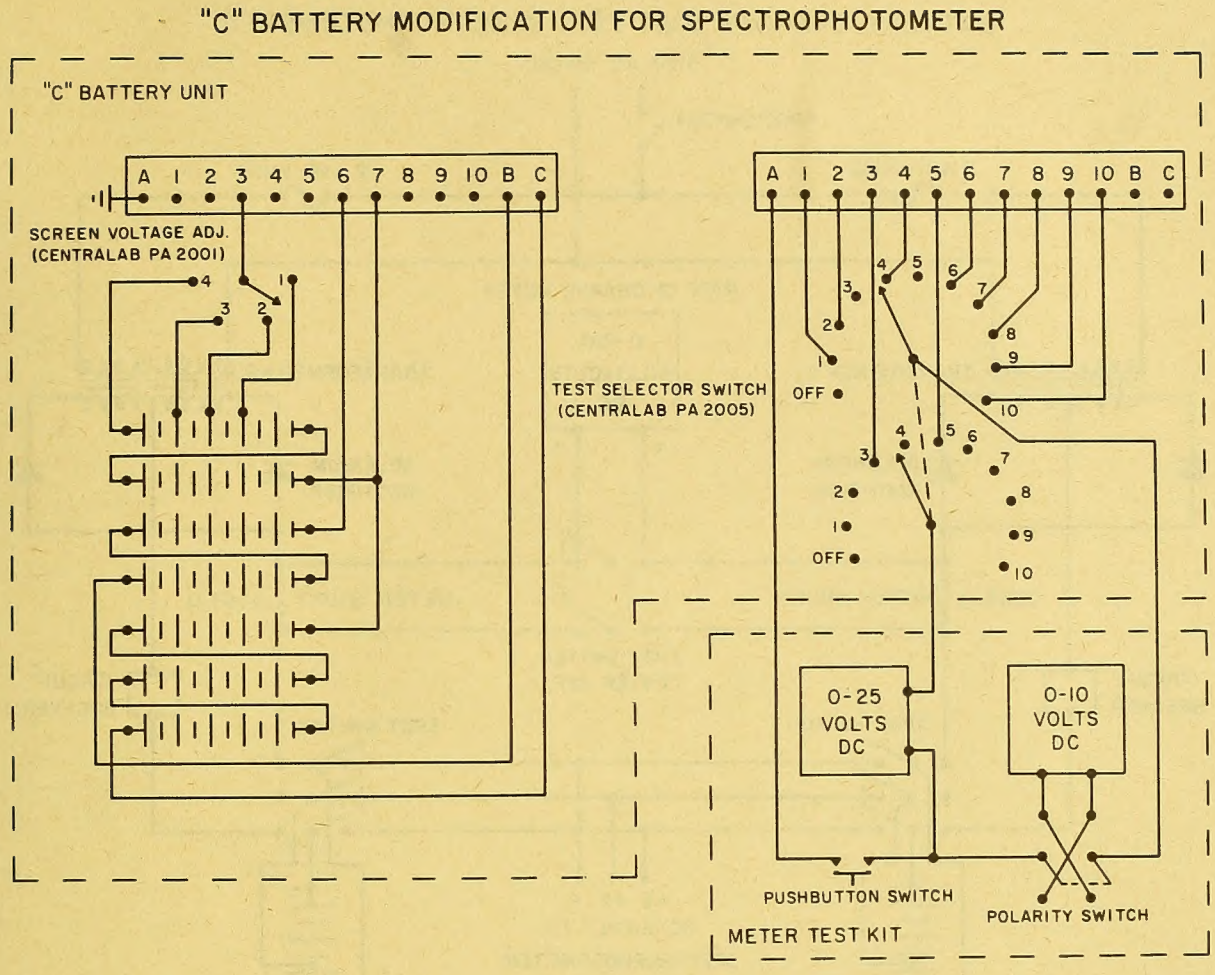

Figure 4.--Diagram of wiring in "C" battery unit and meter test unit. (Terminal strip positions B and C are connected to the yellow and white leads in the Beckman DU Spectrophotometer, respectively.)

meter which shows the rate of charge of the batteries. In addition, the operator may select from this unit the battery which will be used during the operation of the instrument.

The "A" batteries are contained in a separate box and may be placed in some convenient or remote location. Connection between the storage battery box and charger unit is made by a six-conductor "extension" cord equipped with polarized amphenol or similar connectors. These connectors (also used elsewhere in the modified instrument) have given excellent service and have shown no tendency to corrode under these conditions.

Figure 5 shows the wiring diagram for the battery charger unit.

Due to a vessel's motion the level of the electrolyte in the "A" batteries (i.e., 6-volt storage batteries) must be kept at a high level or an unstable dark current will result. Mounting these batteries athwartships also helps stabilize the dark current for the same reason. Also, best results have been obtained by soldering the 6-volt, 2-volt, and negative leads directly to the battery.

Modification of Cell Holder

One spectrophotometer is used solely for the measurement of phytoplankton pigments. In tropical waters this requires the use of a 10-cm. path length and an absorption cell of relatively small volume (i.e., ca. 5-6 ml.)

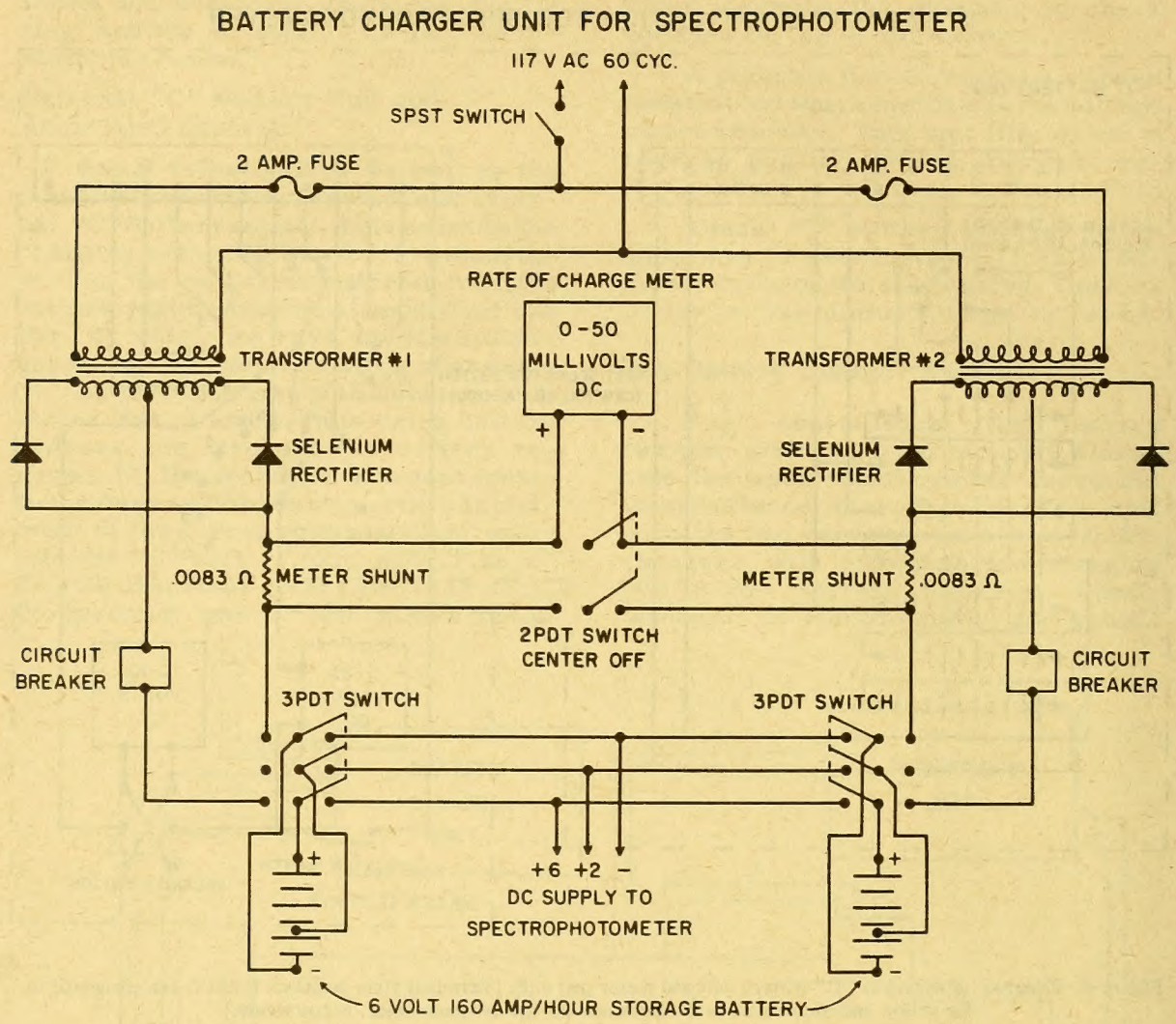

Figure 5.--Wiring diagram (semidiagrammatic) of battery charger unit.

if the volume of water to be filtered is to be kept below 6 liters. The measurement of extinction at the various wave lengths has been made less time consuming by the construction of a cell holder which will accommodate as many as four semimicroabsorption cells.

DISCUSSION AND CONCLUSIONS

While the modifications described are not in any sense radical, they have greatly simplified the maintenance and operation of the DU Spectrophotometer both in the laboratory and especially on oceanographic research vessels. Instruments provided with these modifications have given virtually trouble-free operation over the past 2 years under most severe field conditions.

The authors have not used the Beckman 14500 battery power regulator nor the newer batteryless power supply (Beckman 23700) under field conditions. These units, especially the latter, have not been so employed because they would require special skills in repairing. Furthermore, spare parts for such equipment are not generally available in foreign ports, whereas batteries such as are used in the conventional DU Spectrophotometer power supply are available almost everywhere.

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